

Science Lessons for Grades 6-8

“Antarctic Ecosystems and Understanding Climate Change”

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Discipline: Climate change, ecosystem species populations, and food webs, while maintaining an interdisciplinary focus between mathematics and science. The unifying theme for these topics is Antarctica, the region

Grade: 6 to 8

Standards

1B/M1b, 1B/M1a, 1C/M1, 1C/M4, 1C/M8, 1C/M9, 2B/M1, 2C/M2b, 3A/M2, 4B/M2ab, 4B/M6, 4B/M9, 4B/M12, 4B/M14, 4C/M2b, 4C/M5, 5A/M1, 5A/M5abc, 5A/M5d, 5D/M1b, 5D/M2, 5D/M4, 11C/M7, 12A/M3, 12B/M7b, 12D/M6

Purpose/Goal

Students should be able to describe the climate in the region over time by studying the sedimentary layers in an Antarctic sediment core. They will also be able to apply what they've learned about Antarctic sediment to other regions of the world. Students will be able to calculate species distribution based on sample size, and then calculate the percent error when using a small sample pools vs. a larger sample pools. Students will be able to discuss the role of organisms in the Antarctic marine ecosystem and construct a food web. They will also be able to apply their understanding of food webs to organisms in other regions of the world.

Context

Some misconceptions related to climate change include the age of the Earth, the ability to date sediment and rocks, the ability for major climatic events to be interpreted from sediment, and the importance of studying Antarctica. Students should have basic understanding of the geologic time scale, and most importantly the age of the Earth. Additionally, they should be introduced to fossils and deposition of sediment, as well as an introduction to absolute/relative dating. These pre-requisite topics are included in the NJ core curriculum content standards and therefore don't require additional pre-requisite lessons.

This lesson fits in with a series of lessons relating to the graduate fellows research, and bridges the transition in curriculum between “Earth History” to “Classification and Biomes”.

Preparation

This lesson contains three activities which occur in the classroom simultaneously. We call each activity a “station” which takes place in different places throughout the classroom.

Station 1: Quantifying Antarctic ecosystems

- Activity sheet
- Foam board with grid drawn
- 60 assorted organisms
- Toothpicks (to attach organisms to foam board)

Station 2: Antarctic Food Webs

- Activity sheet
- 8-10 note cards with an image of an organism from Antarctica
- Yarn
- Computers with internet access

Station 3: Antarctic Sediment (this may be difficult for some teacher to acquire)

- Activity sheet
- Sediment core with distinguishable layers (as an alternative: obtain an image of a sedimentary core with distinguishable layers and print an enlarged image ~1m long)
- Tape measure

Websites

- <http://www.antarcticconnection.com>
- <http://www.classroom.antarctica.gov.au/>
- <http://www.andrill.org/>
- <http://www.usap.gov/>
- <http://www.hamilton.edu/news/exp/Antarctica/2006/students.html>

Motivation

A good way to introduce the topic is to discuss the reasons why scientists conduct research in Antarctica. We first identify the continent on the globe and have a discussion about how long it takes to travel there, and allow the students to ask various questions about Antarctica. Then, we ask them a question, "Why would anyone spend all that time and money to travel all the way to Antarctica?" Students often respond by talking about undiscovered species, which is an excellent response. We then have a discussion about the conditions in Antarctica which make it a great region for observing changes in climate throughout geologic time. I also bring pictures into the classroom from my trip to Antarctica. The students are full of questions and comments, which is a great way to get them interested in the upcoming lesson.

Description

This lesson is designed to be carried out over a three to four day period. This type of lesson is quite unique and requires inquiry based group work. The students in the class are divided into three groups (typically 6-8 per group). Each group spends an entire day at a Station (outlined in "planning ahead"). Each day the students rotate to another station. After three days of rotating, the students will have completed the activities.

Station 1: Quantifying Antarctic ecosystems

- The teacher must cut out 60 organisms (we used: 13 krill, 30 diatoms, 2 orca whales, 8 seals, 5 penguins).
- The students are provided with a large foam board with a (5 x 5 box) grid drawn on it. The organisms have a toothpick taped to them which is inserted into the foam board allowing them to stand upright.
- The students are asked to count the organisms of each type in particular box on the grid. The students use that data to calculate the number of organisms in the ecosystem (the entire grid).
- The students are then asked to count the organisms of each type in multiple boxes and use that data to calculate the number of each organism in the entire ecosystem.
- After the students have collected their data, they calculate the percent error when only studying using a small sample pool (one box) versus the percent error when studying a larger sample pool (multiple boxes).

Station 2: Antarctic Food Webs

- The student are each given a note-card with an organism from Antarctica (we used: skua, leopard seal, adielie penguin, diatoms, ice fish, weddell seal, krill, orca whale, glacial squid).
- They wear the card around their neck (I attach yarn to the card) and use the internet to research what that organism feeds on, what feeds on that organism, and its role in the ecosystem.
- The students must then hypothesize what might happen if their organism is removed from the ecosystem and discuss how it would affect other organisms.
- Once they have completed their research, the students are asked to construct a food web which incorporates each of their assigned organisms.
- The students are instructed to draw their food web, labeling organisms and describe who is eating who.
- As an extension if time permits, the student can form a circle and the "diatom" is given a ball of yarn. He/she is asked to hold the end of the yarn and throw the ball to an organism that consumes them. This continues until all the organisms have been preyed upon or until it reaches a top consumer. Once all students are holding a piece of the yarn, ask one student to let go. Discuss what happens to the ecosystem when one organism is removed (it collapses).

Station 3: Antarctic Sediment (this may be difficult for some teacher to acquire)

- The students are provided with approximately 4 meters length of sediment from Antarctica. As an alternative, teachers could use an image (pasted together) illustrating marine sediment layers. We used sediment that has distinct brown and light green layers which indicate if diatoms (green) are present.
- The students are asked to hypothesize what the different layers might indicate.
- The students are given the age of the sediment at the base and top of the core and are instructed to measure the entire length of the core (s).
- The students must calculate the sedimentation rate based on the amount of time recorded in the sediment. For example, the core we used represented 2,000 years of sediment and measured 4 meters. The sedimentation rate was 2mm per year.
- The students then need to count the number of times they see changes in the color of the sediment layers.

- They then calculate how often the climate changes (or how often sea temperature changes in our case).
- The students are asked to use this data to construct a “downcore profile”. The student were provided with the core log that was created on the ship when the sediment was first collected from Antarctica. The students draw the core and label the shifts in temperature and describe the sediment.
- Finally, they are asked to summarize what happened during the 2,000 period represented by the sediment.

Assessments

We allow the students to work in groups therefore an individual grade isn't necessarily given. Instead, we are concerned with students' understanding and their ability to discuss what they have learned. The activity sheets are collected and kept in a book specific to GK-12 activities. We periodically review past activities to gauge student understanding and retention. The students are however held accountable for completing their work. Key concepts from these activities are included on their chapter examinations and are generally in essay/short answer format.

Follow-Up Activities

There is much more that can be incorporated into these activities. After having the students research Antarctica, they can use the skill they acquired from this lesson to study other regions of the world. They can also compare climate data and organisms from other geographic regions. A great extension would be to compare the Arctic and discuss organisms that are unique to each polar region